Environmental Product Declaration

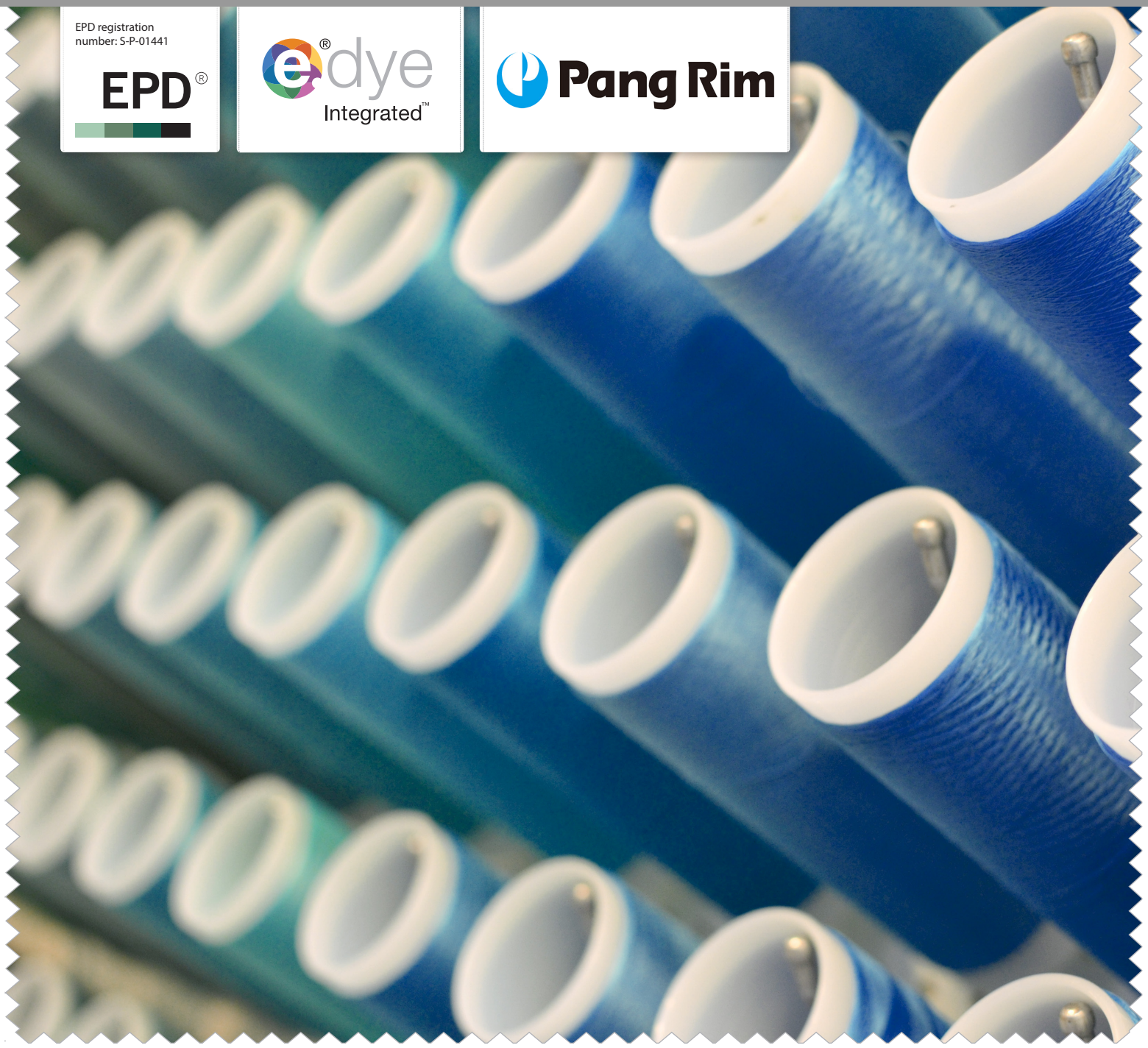
In accordance with ISO 14025 for: Mélange and twill T/C blends (dope dyed and piece dyed versions) from PangRim Co., Ltd.

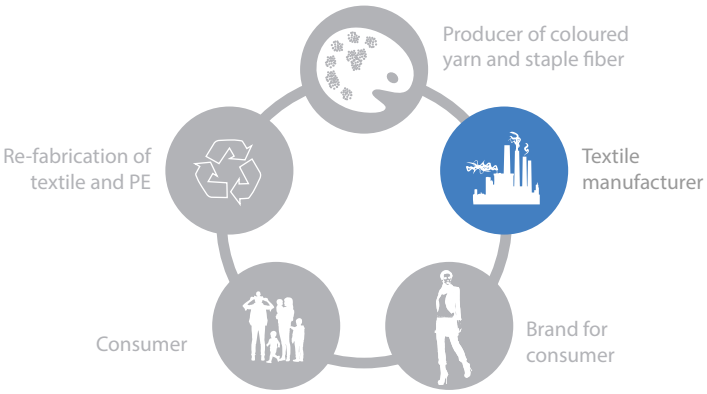
EPD registration number: S-P-01441

EPD®

edye® Integrated™

Pang Rim





Pang Rim

About PangRim

Owner of the EPD:
PangRim Co. Ltd.

Description of the organisation: PangRim was established in 1963 and produces a broad range of popular products including pure cotton and mixed cotton, linen, rayon, tencel, polyester, nylon, and elastic woven fabrics.

Name and location of production site:

Yarn: Smartex Ltd. Kunshan, China
Fabric: PangRim Co. Ltd., Seoul, South Korea

About e.dye

With over 20 years of experience, e.dye Ltd has the R&D and know-how to offer customers a wide range of support and value added services that provide a competitive edge.

By controlling the entire supply chain, we make our own recipe by producing our masterbatch 100% in-house. This is then sent throughout the supply chain with clear instructions for the best end result on fabric ready for Gmt production. We ensure that quality meets the highest standards.

e.dye® Waterless Color System™ offers an environmentally sustainable process for dyeing fabrics. Using the solution dyed polyester process, e.dye® requires no water to dye synthetics. By adding the color before the polymers are extruded, the color is inside the yarn, resulting in superior color performance.

e.dye is a solution dyed polyester color system with over 2,500 colors and a sophisticated color-matching process for garment textiles. e.dye is a paradigm shift in textile dyeing, because e.dye actually puts the color inside the yarn.

About EPD

An Environmental Product Declaration (EPD) is an independently verified and registered document that communicates transparent and comparable information about the life cycle environmental impact of products. The relevant standard for Environmental Product Declarations is ISO 14025, where they are referred to as "Type III environmental declarations". A Type III environmental declaration is created and registered in the framework of a programme, such as the International EPD® System.

The International EPD® System has, as a main objective, the ambition to enable and support organisations in any country to communicate quantified environmental information on the life cycle of their products in a credible, comparable, and understandable way. All EPDs registered in the International EPD® System are publically available and free to download on this website: www.environdec.com.

All EPDs are based on Product Category Rules providing rules, requirements, and guidelines for a defined product category. The overall goal of an EPD is to provide relevant and verified information to meet the communication needs in the various applications: procurement, ecodesign or environmental management systems. An important aspect of EPD is to provide the basis of a fair comparison of products and services by its environmental performance. EPDs can reflect the continuous environmental improvement of products and services over time and are able to communicate and add up relevant environmental information along a product's supply chain.

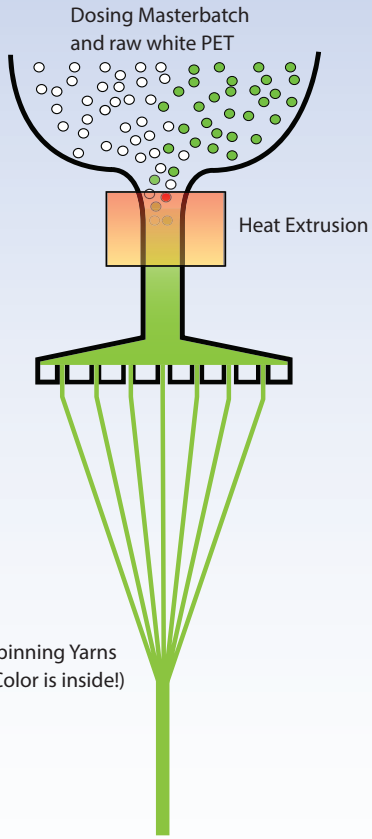
This is the e.dye technique

e.dye is a solution dyed polyester color system with over 2,500 colors and a sophisticated color-matching process for textiles. Solution dyeing means putting color inside the masterbatch chips, melt spun and extruded into yarn in color, instead of extruding raw white yarn that is later dyed in traditional water dye process.

What is e.dye?

Raw stock PET or rPET
Lusters available: bright, semidull and full dull. Up to 95% recycled. GRS Certified.

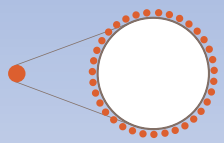
Masterbatch Colors - in stock
Made in-house by e.dye, according to a recipe tied to 2,500 colors in the e.dye Color Bank.



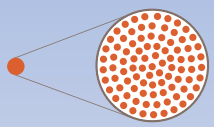
This process eliminates water consumption and reduces chemical use, energy comsumption and CO_2 emissions.

Why is e.dye better?

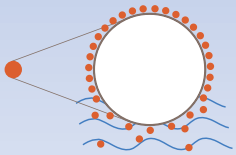
Traditional Piece Dye
Color is outside - of the surface of the yarn filament.

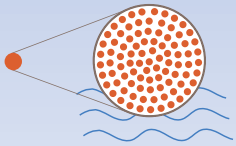


e.dye® Waterless Color System™
Color is inside - evenly dispersed throughout the entire yarn filament.

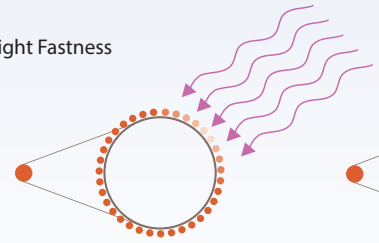


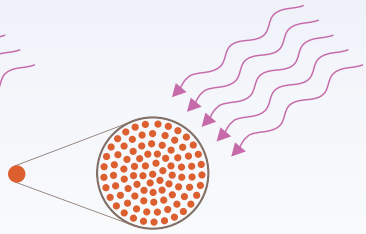
Wash Fastness

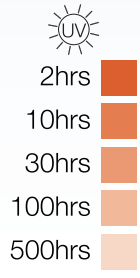


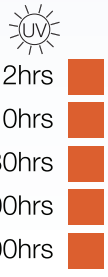


Light Fastness









Product information

Polyester/cotton blend fabrics (dope dyed and piece dyed versions)

Two types of mélange and one twill T/C blends have been studied in two versions: dope dye and piece dye, see Table 1.

These fabrics are designed for work wear with a long service life time; thus they have a thick construction and heavy weight. The technical specifications are found in Table 3.

Table 1. Polyester/cotton blend fabrics.

	295 g/sqm fabric (based on yarn size 14/12	245 g/sqm fabric (based on yarn size 20/14)	280 g/sqm 86/14 PES/CO twill (3/1) with filament face and P/C back
dope dye	Fabric 1: 8616	Fabric 3: 8617	Fabric 5: TXPC300F–1
piece dye	Fabric 2: V1480	Fabric 4: 2500	Fabric 6: PC FABRIC

Other product information

Product identification:
CPC 267 Woven, knitted or crocheted fabrics

UN CPC code:
267

Geographical scope:
Global

LCA information

Goal of the study

An LCA study has been conducted in accordance with ISO 14044 and the requirements stated in the General Programme Instructions by The International EPD® System (EPD International, 2017).

The goal of the present LCA study has been to calculate environmental impact values for polyester/cotton blend fabrics (see Table 1), both dope dye and piece dye versions to create this Environmental Product Declaration, to be used for communicating environmental performance to customers.

Scope of the study

The scope of this study is cradle to gate and includes all processes up until the fabric is finished, see Figure 1. All material and resource consumption is tracked back to the point of raw material extraction, mainly by using cradle-to-gate data from the Ecoinvent database (Ecoinvent, 2018). The functional unit of the study is 1 (one) square meter of fabric, in accordance with the Product Category Rules (PCR) (EPD International, 2012).

Data collection

The inventory for the LCA study was carried out during April/May 2018, collecting data for 2017 and 2018. The on-site visits covered all manufacturing processes from fibre to fabric:

- masterbatch production: single pigment colour (SPC) or multipigment colour (MPC),
- polyester staple fibre as well filament yarn manufacturing (melt spinning, drawing, texturizing and (for staple fibres) cutting,
- mélange yarn spinning,
- weaving,
- fabric wet treatment (scouring, dyeing and finishing).

Allocation

Whenever it has been necessary to partition the system inputs and outputs, mass criteria has been used in accordance with the PCR (EPD International, 2012). Such situations have for example been when the share of energy and water consumption of an entire production plant has been allocated to the specific fabric based on the total production volume of the plant.

Cut-off rules

The PCR states that life cycle inventory data for a minimum of 99% of total inflows to the three life cycle stages (up-stream, core and down-stream modules) shall be included and a cut-off rule of 1% regarding energy, mass and environmental relevance shall apply (EPD International, 2012).

The downstream process included in the system boundary, the transport to the customer (garment makers), gives a negligible contribution to the environmental impact (<1% for all categories) and is not included

Assumptions and limitations

Some general assumptions have been made around transport vehicle to fit the database data from Ecoinvent (Ecoinvent, 2018). Country electricity mix datasets have been used for electricity when the site reports that they use the country electricity net.

Generally, the LCA data should be used with precaution if interpreted for any other purpose than this EPD.

Data quality

The data quality has been considerably increased by the experience from making a similar study in the past (EPD International, 2015).

Additional information about the LCA study

Time representativeness:
2017-2018

Database(s) and LCA software used:
SimaPro version 8.5.0.0,
(PRé Consultants, 2018)
ecoinvent version 3.4,
(Ecoinvent, 2018)

Description of system boundaries:
cradle-to-gate

LCA practitioner:
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Third party reviewer:
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[1] Cradle-to-gate = all processes from cradle (mining site, forest etc.) to gate (until the goods is produced and ready for delivery at the factory gate).

System diagram

The system boundaries of this EPD are decided by the Product Category Rules (PCR) and illustrated by Figure 1.

Garment manufacturing, retail, use and end-of-life processes are not included. The only downstream process included in the system boundary, the transport to the customer (garment makers), was found to give a negligible contribution to the environmental impact (<1% for all categories). Therefore the downstream phase is not reported separately.

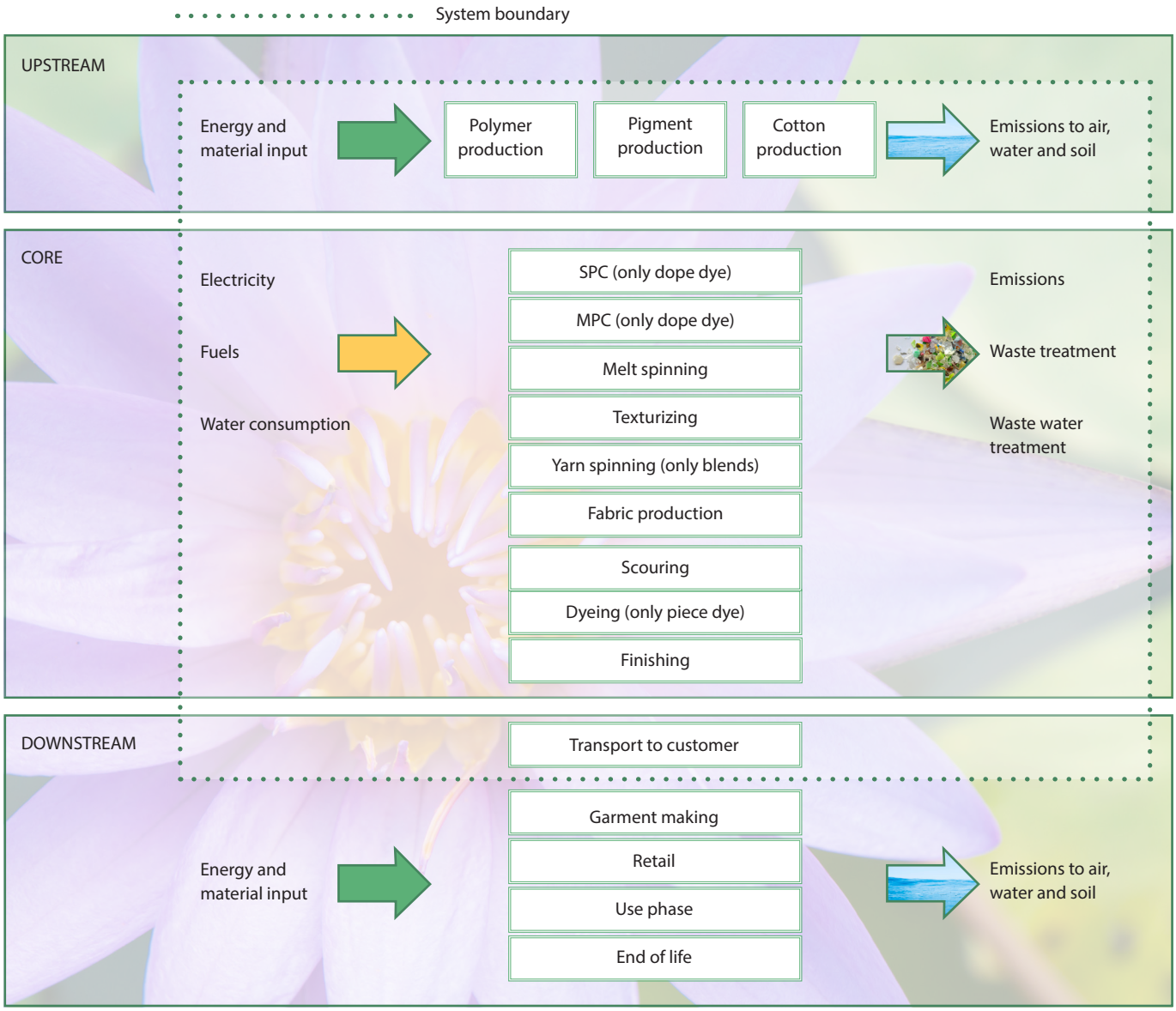


Figure 1. The system boundaries include upstream, core and downstream processes.

Content declaration

Product

The fabrics consist of polyester (PES, polyethylene terephthalate) and cotton (CO) fibre blends, specified in Table 2. The presence of substances above the restricted levels in applicable regulations (e.g. the European Regulations on substances and preparations) is controlled by Oeko-tex certification and supplier dialogue.

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product:
The polyester is recycled post-consumer waste, certified via Global Recycle Standard (GRS).

Product characteristics

The product characteristics are presented in Table 3.

Table 2. Product content.

MATERIALS	% PES	% CO
Dope dye mélange, 295 g/sqm	65	35
Piece dye, 295 g/sqm	65	35
Dope dye mélange, 245 g/sqm	65	35
Piece dye, 245 g/sqm	65	35
Dope dye twill, 280 g/sqm	86	14
Piece dye twill, 280 g/sqm	60	40

Table 3. Product Characteristics.

PRODUCT CHARACTERISTICS						
FABRICS	1. Dope dye mélange, 295 g/sqm	2. Piece dye solid, 295 g/sqm	3. Dope dye mélange, 245 g/sqm	4. Piece dye solid, 245 g/sqm	5. Dope dye twill, 280 g/sqm	6. Piece dye twill, 280 g/sqm
	8616	V1480	8617	2500	TXPC300F-1	PC FABRIC
CONSTRUCTIVE CHARACTERISTICS						
Composition Regulation (EU) No 1007/2011	PES: 65 % CO: 35 %	PES: 65 % CO: 35 %	PES: 65 % CO: 35 %	PES: 65 % CO: 35 %	PES: 86 % CO: 14 %	PES: 60 % CO: 40 %
Weave	Woven fabrics ISO 3672/76					
Mass per unit area [g/m2] ISO 3801 EN 12127	295	295	245	245	280	280
Width [cm]	152	152	152	152	152	152
DYEING						
Colour Index	Carbon black		Pigment blue 15:3 ; Pigment violet 23 ; Carbon black		Pigment green 7 ; Solvent yellow 98	
PERFORMANCE CHARACTERISTICS						
Tensile strength (N) ISO13934-1	W 1,700 F 900	W 1,700 F 900	W 1,300 F 900	W 1,300 F 900	W 1,600 F 600	W 1,600 F 600
Tearing strength (N) ISO13937-1	W 53 F 53	W 53 F 53	W 53 F 53	W 53 F 53	W 53 F 53	W 53 F 53
Martindale Pilling test EN ISO 12945/02 - Part 2 5000 rubs	3	3-4	2-3	3-4	4	3-4
Martindale Abrasion test EN ISO 12947/00, 12kpa	50,000	50,000	50,000	50,000	50,000	50,000
pH of water extract EN ISO 3071/06	5-7.5	5-7.5	5-7.5	5-7.5	5-7.5	5-7.5
Dimensional change to washing 60°C [%] EN ISO 6330:2002 tumble dry 85°C	+/- 3	+/-3	+/-3	+/-3	+/-3	+/-3

COLOUR FASTNESS						
Light Xenon test UNI EN ISO 105 B02/04	4	4	4	4	4	4
Wash with commercial household detergent at 60°C UNI EN ISO 105 C06/99	Change 4-5 stain 4	Change 4-5 stain 3-4	Change 4 -5 stain 4	Change 4-5 stain 3-4	Change 4-5 stain 4	Change 4 stain 3-4
Wash with commercial household detergent at 85°C UNI EN ISO 105 C06/99	Change 4-5 stain 3-4	Change 4 stain 3	Change 4-5 stain 3-4	Change 4 stain 3	Change 4-5 stain 3-4	Change 4 stain 3
Water UNI EN ISO 105 E01/98	4-5	4	4-5	4	4-5	4
Chlorine UNI EN ISO 105 E03/98	4-5	4	4-5	4	4-5	4
Acid and alkaline perspiration UNI EN ISO 105 E04/98	4-5	4	4-5	4	4-5	4
Dry and wet rubbing UNI EN ISO 105 X12/03	DRY 4-5 WET 4	DRY 4 WET 3	DRY 4-5 WET 4	DRY 4 WET 3	DRY 4-5 WET 4	DRY 4 WET 3

Environmental performance

The only downstream process included in the system boundary, the transport to the customer (garment makers), was found to give a negligible contribution to the environmental impact (<1% for all categories). Therefore the downstream phase is not reported separately.

PARAMETER		UNIT	Fabric	Upstream	Core	TOTAL
Global warming potential (GWP)	Fossil	kg CO2 eq.	1.Melange 295, dope dyed	0.87	2.83	3.70
			2.295, piece dyed	0.82	3.75	4.57
			3.Melange 245, dope dyed	0.72	2.35	3.07
			4.245, piece dyed	0.68	3.12	3.80
			5.Twill, dope dyed	0.86	2.68	3.54
			6.Twill, piece dyed 0.82	0.82	3.56	4.38
	Biogenic	kg CO2 eq.	1.Melange 295, dope dyed	0.061	0.192	0.253
			2.295, piece dyed	0.059	0.390	0.449
			3.Melange 245, dope dyed	0.050	0.160	0.210
			4.245, piece dyed	0.049	0.324	0.373
			5.Twill, dope dyed	0.054	0.183	0.237
			6.Twill, piece dyed	0.053	0.370	0.423
	Land use and land transformation	kg CO2 eq.	1.Melange 295, dope dyed	0.0022	0.0018	0.0040
			2.295, piece dyed	0.0022	0.0020	0.0042
			3.Melange 245, dope dyed	0.0018	0.0015	0.0033
			4.245, piece dyed	0.0018	0.0017	0.0035
			5.Twill, dope dyed	0.0023	0.0017	0.0040
			6.Twill, piece dyed	0.0022	0.0019	0.0042
	TOTAL	kg CO2 eq.	1.Melange 295, dope dyed	0.91	2.88	3.79
			2.295, piece dyed	0.86	3.83	4.69
			3.Melange 245, dope dyed	0.75	2.40	3.15
			4.245, piece dyed	0.71	3.18	3.89
			5.Twill, dope dyed	0.89	2.74	3.63
			6.Twill, piece dyed	0.85	3.63	4.48

Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	1.Melange 295, dope dyed	8.52E-08	2.48E-07	3.33E-07
		2.295, piece dyed	8.13E-08	3.28E-07	4.09E-07
		3.Melange 245, dope dyed	7.07E-08	2.06E-07	2.77E-07
		4.245, piece dyed	6.75E-08	2.72E-07	3.4E-07
		5.Twill, dope dyed	8.46E-08	2.35E-07	3.2E-07
		6.Twill, piece dyed	8.12E-08	3.11E-07	3.93E-07
Acidification potential (AP)	kg SO2 eq	1.Melange 295, dope dyed	6.54E-03	9.86E-03	1.64E-02
		2.295, piece dyed	6.12E-03	1.30E-02	1.91E-02
		3.Melange 245, dope dyed	5.43E-03	8.19E-03	1.36E-02
		4.245, piece dyed	5.08E-03	1.08E-02	1.59E-02
		5.Twill, dope dyed	6.70E-03	9.36E-03	1.61E-02
		6.Twill, piece dyed	6.33E-03	1.24E-02	1.87E-02
Eutrophication potential (EP)	kg PO43- eq.	1.Melange 295, dope dyed	2.98E-03	6.25E-03	9.23E-03
		2.295, piece dyed	2.87E-03	7.80E-03	1.07E-02
		3.Melange 245, dope dyed	2.47E-03	5.19E-03	7.67E-03
		4.245, piece dyed	2.38E-03	6.47E-03	8.86E-03
		5.Twill, dope dyed	3.07E-03	5.94E-03	9.00E-03
		6.Twill, piece dyed	2.97E-03	7.40E-03	1.04E-02
Formation potential of tropospheric ozone (POCP)	kg C2H4 eq.	1.Melange 295, dope dyed	3.62E-04	2.09E-04	5.71E-04
		2.295, piece dyed	5.22E-04	1.75E-04	6.97E-04
		3.Melange 245, dope dyed	3.01E-04	1.74E-04	4.74E-04
		4.245, piece dyed	4.33E-04	1.46E-04	5.79E-04
		5.Twill, dope dyed	3.44E-04	2.03E-04	5.47E-04
		6.Twill, piece dyed	4.95E-04	1.74E-04	6.69E-04
Water scarcity potential	m3 eq.	1.Melange 295, dope dyed	13.93	1.02	14.95
		2.295, piece dyed	13.90	1.63	15.53
		3.Melange 245, dope dyed	11.57	0.85	12.42
		4.245, piece dyed	11.54	1.36	12.90
		5.Twill, dope dyed	15.09	0.97	16.06
		6.Twill, piece dyed	15.06	1.55	16.61

Use of resources

PARAMETER		UNIT	Fabric	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	1.Melange 295, dope dyed	8.09	0.65	8.74
			2.295, piece dyed	8.06	0.86	8.91
			3.Melange 245, dope dyed	6.72	0.54	7.26
			4.245, piece dyed	6.69	0.71	7.40
			5.Twill, dope dyed	8.71	0.61	9.32
			6.Twill, piece dyed	8.68	0.81	9.49
	Used as raw materials	MJ, net calorific value	All fabrics[2]	0	0	0
	TOTAL	MJ, net calorific value	1.Melange 295, dope dyed	8.09	0.65	8.74
			2.295, piece dyed	8.06	0.86	8.91
			3.Melange 245, dope dyed	6.72	0.54	7.26
			4.245, piece dyed	6.69	0.71	7.40
			5.Twill, dope dyed	8.71	0.61	9.32
			6.Twill, piece dyed	8.68	0.81	9.49

[2] No renewable primary energy resources are used as raw materials for either fabric 1, 2, 3, 4, 5 or 6.

Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	1.Melange 295, dope dyed	10.85	51.90	62.75
			2.295, piece dyed	10.30	65.35	75.65
			3.Melange 245, dope dyed	9.01	43.10	52.11
			4.245, piece dyed	8.56	54.27	62.83
			5.Twill, dope dyed	10.55	49.26	59.81
			6.Twill, piece dyed	10.07	62.02	72.09
	Used as raw materials	MJ, net calorific value	1.Melange 295, dope dyed	1.09E-02	0	1.09E-02
			2.295, piece dyed	1.09E-02	0	1.09E-02
			3.Melange 245, dope dyed	9.07E-03	0	9.07E-03
			4.245, piece dyed	9.07E-03	0	9.07E-03
			5.Twill, dope dyed	9.57E-03	0	9.57E-03
			6.Twill, piece dyed	9.57E-03	0	9.57E-03
	TOTAL	MJ, net calorific value	1.Melange 295, dope dyed	11.06	51.90	62.95
			2.295, piece dyed	10.51	65.35	75.86
			3.Melange 245, dope dyed	9.18	43.10	52.28
			4.245, piece dyed	8.73	54.27	63.00
			5.Twill, dope dyed	10.73	49.26	59.99
			6.Twill, piece dyed	10.25	62.02	72.28
Secondary material		kg	1.Melange 295, dope dyed	0.21	0	0.21
			2.295, piece dyed	0.21	0	0.21
			3.Melange 245, dope dyed	0.17	0	0.17
			4.245, piece dyed	0.17	0	0.17
			5.Twill, dope dyed	0.18	0	0.18
			6.Twill, piece dyed	0.18	0	0.18
Renewable secondary fuels		MJ, net calorific value	All fabrics[3]	0	0	0
Non-renewable secondary fuels		MJ, net calorific value	All fabrics[4]	0	0	0
Net use of fresh water		m^3	1.Melange 295, dope dyed	0	0.0110	0.0110
			2.295, piece dyed	0	0.0243	0.0243
			3.Melange 245, dope dyed	0	0.0092	0.0092
			4.245, piece dyed	0	0.0202	0.0202
			5.Twill, dope dyed	0	0.0105	0.0105
			6.Twill, piece dyed	0	0.0231	0.0231

Waste production and output flows

Waste production

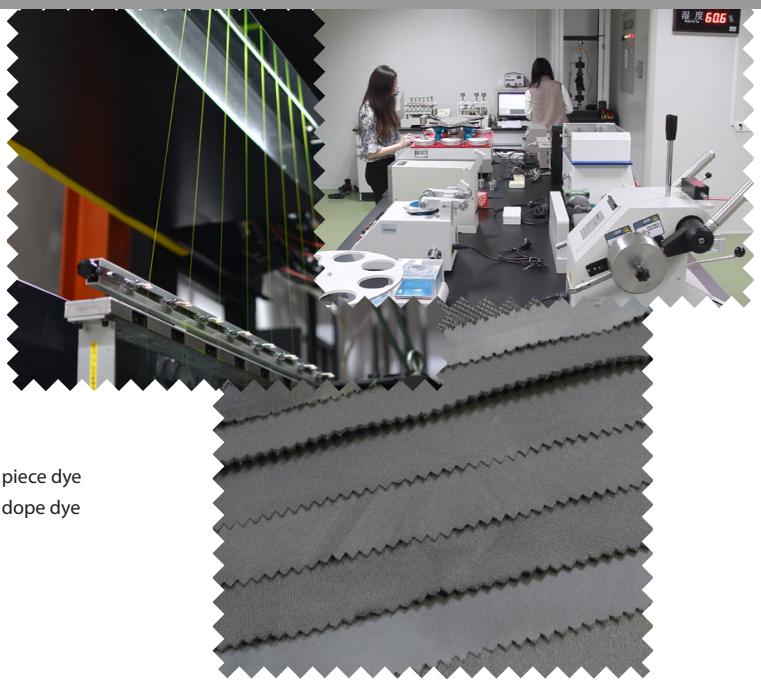
PARAMETER	UNIT	Fabric	Upstream	Core	TOTAL
Hazardous waste disposed	kg	All fabrics[5]	0	0	0
Non-hazardous waste disposed	kg	1.Melange 295, dope dyed	0	0.11	0.11
		2.295, piece dyed	0	0.11	0.11
		3.Melange 245, dope dyed	0	0.09	0.09
		4.245, piece dyed	0	0.09	0.09
		5.Twill, dope dyed	0	0.10	0.10
		6.Twill, piece dyed	0	0.10	0.10
Radioactive waste disposed	kg	All fabrics[6]	0	0	0

[3]No renewable secondary fuels are used for neither fabric 1, 2, 3, 4, 5 or 6.
[4]No non-renewable secondary fuels are used for neither fabric 1, 2, 3, 4, 5 or 6.
[5]No hazardous waste is disposed for neither fabric 1, 2, 3, 4, 5 or 6.
[6]No radioactive waste is disposed for neither fabric 1, 2, 3, 4, 5 or 6.

Additional information

The diagrams below show selected results from the Environmental performance tables per kilogram (kg) fabric.

The water savings from e.dye technology for the mélange fabrics is illustrated in Figure 2. 38 litres of water is saved for each kilogram fabric produced with e.dye technology instead of conventional dyeing[7]. Only the polyester content (65%) is dyed while the cotton (35%) remains un-dyed. The water use in the pre-treatment is due to the cotton content for which scouring, bleaching, mercerization and neutralizing is made.



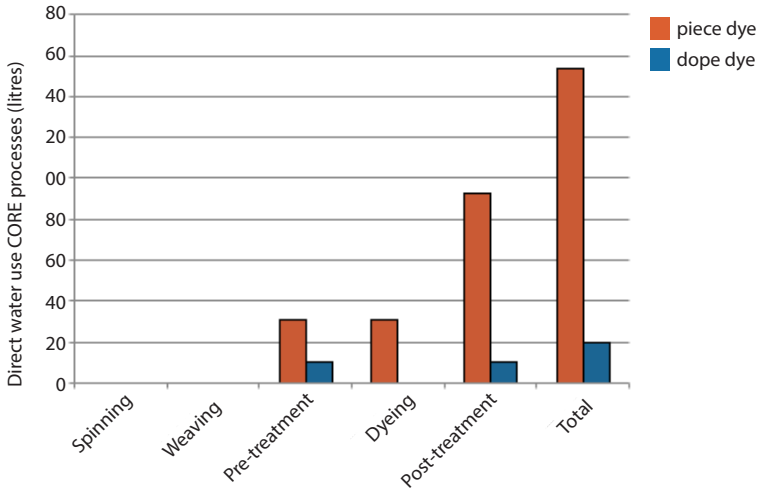


Figure 2. The water savings with the e.dye process (dope dye) compared to conventional dyeing (piece dye) for the core processes. Figures per kg of fabric.

The global warming potential for the core processes for the mélange fabric is shown in Figure 3. The spinning step includes masterbatch production as well as both polyester staple fibre and mélange yarn spinning, and wet treatment includes scouring, dyeing and finishing.

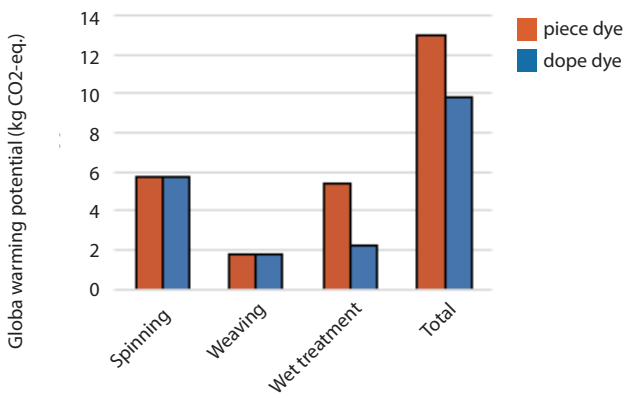


Figure 3. The global warming potential with the e.dye process (dope dye) compared to conventional dyeing (piece dye) for the core processes. Figures per kg of fabric.

Figure 4 shows the use of chemicals (amounts of input chemicals) for the core processes for the mélange fabric.

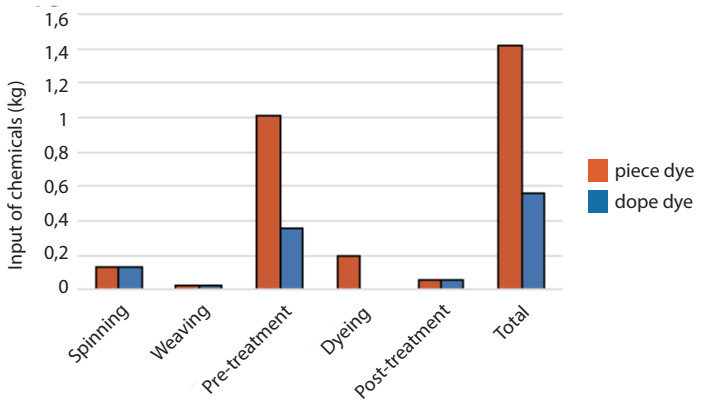


Figure 4. The amount of input chemicals for the e.dye process (dope dye) compared to conventional dyeing (piece dye) for the core processes. Figures per kg of fabric.

[7] The Taimao factory has a rather large rate of rework, and the average consumption of water is reported to 154 kg water per kg fabric. The theoretical water usage for piece dye is 50 liters of water per kg fabric.

Programme-related information and verification

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable.

Programme:
The International EPD® System

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EPD registration number:
S-P-01441

Published:
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Valid until:
2024-04-29

Product Category Rules:
pcr2012-14 v2.0 Woven knitted or crocheted fabrics

Product group classification:
UN CPC 267 Woven fabrics (except special fabrics) of man-made filaments and staple fibres
UN CPC 281 Knitted or crocheted fabrics

Reference year for data:
2017-2018

Geographical scope:
Global

Prepared with the assistance of Swerea IVF AB. (Today RISE IVF)

Product category rules (PCR): pcr2012-14 v2.0 Woven knitted or crocheted fabrics UN CPC 267 Woven fabrics (except special fabrics) of man-made filaments and staple fibres UN CPC 281 Knitted or crocheted fabrics
PCR review was conducted by: The Technical Committee of the International EPD® System
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: Marcus Wendin Miljögiraff AB Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

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- Facility B, anonymous, for weaving and sizing.
- Facility C, anonymous for fabric wet treatment and finishing.
- Facility D, anonymous, for staple fibre manufacturing
- Facility E, for mélange yarn spinning

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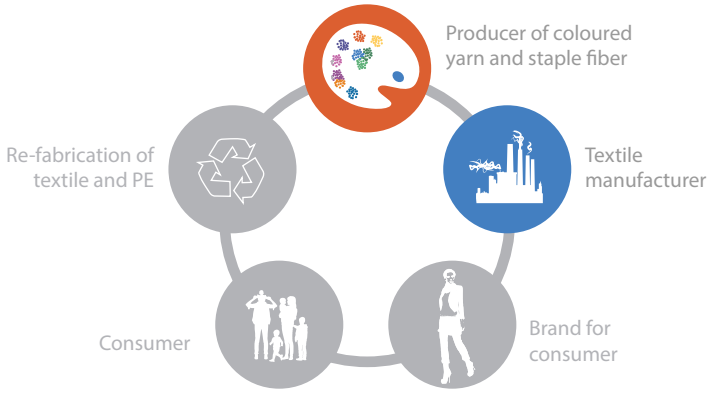

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